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Date of mailing (day/month/year) 26 January 1999 (26.01.99)	
International application No. PCT/IB98/00825	Applicant's or agent's file reference TCBG-HB/vR 2164
International filing date (day/month/year) 28 May 1998 (28.05.98)	Priority date (day/month/year) 04 June 1997 (04.06.97)
Applicant BAIRD-SMITH, Ian et al	

1. The designated Office is hereby notified of its election made:

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European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 98 81 1054

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 92 08656 A (EFFEM GMBH) 29 May 1992 * page 3, paragraph 2; claim 7; figures 1,2 *	1-4,8,9,11,13-17,20-25	B65D43/08
Y		5-7,10,12,18,19	
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Y	DE 11 76 014 B (CROWN CORK & SEAL) * column 1, paragraph 1 - paragraph 3; figure 4 *	10	
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A	GB 194 670 A (PASSAIC METAL WARE)		TECHNICAL FIELDS SEARCHED (Int.Cl.6) B65D
A	US 2 257 715 A (HOPKINS) 30 September 1941		
A	CH 684 077 A (FREI SIEGFRIED) 15 July 1994		
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 4 February 1999	Examiner Spettel, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 81 1054

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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04-02-1999

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Application No: GB 9711462.3
Claims searched: 1-23

Examiner: Peter Emerson
Date of search: 11 August 1997

Patents Act 1977
Search Report under Section 17

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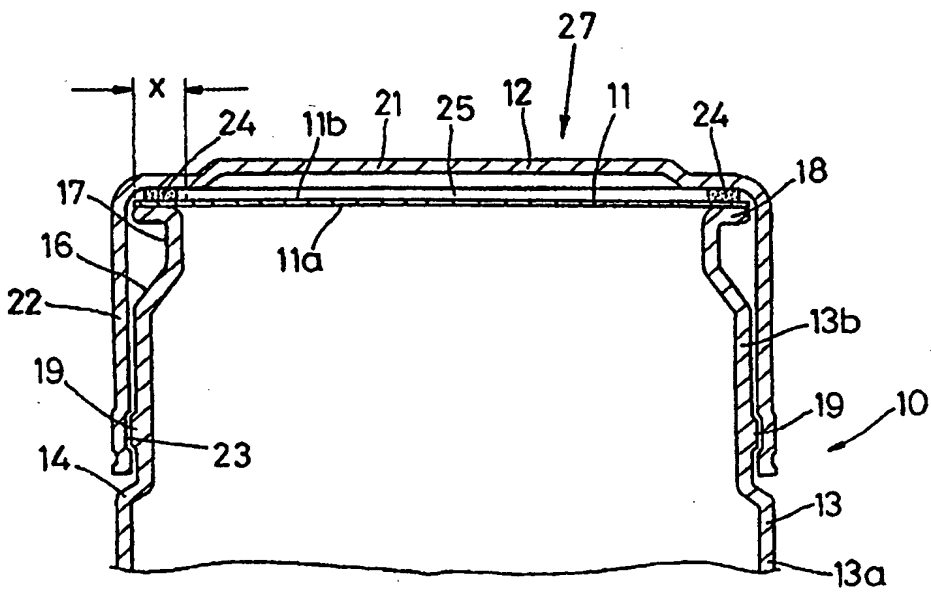
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UK Cl (Ed.O): B8T TCC
Int Cl (Ed.6): 41/50, 41/62, 51/18, 51/20
Other: Online: WPI

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Category	Identity of document and relevant passage	Relevant to claims
X	GB 2123392 A (MARDON) - p1 lines 80-103, fig 2.	1-3, 5, 6, 9, 10
X	US 4683016 A (SUN) - col 3 line 48 - col 4 line 9, fig 1.	1-3, 5, 6, 9-12, 14-17
X	US 4531649 A (ANCHOR) - see claim 1, fig 8.	1-6, 9, 10
X	US 3805993 A (GENERAL) - col 4 lines 24-33, col 5 lines 24-42, fig 2.	1, 4, 8-10, 12

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : B65D 51/20	A1	(11) International Publication Number: WO 98/55374 (43) International Publication Date: 10 December 1998 (10.12.98)
<p>(21) International Application Number: PCT/IB98/00825</p> <p>(22) International Filing Date: 28 May 1998 (28.05.98)</p> <p>(30) Priority Data: 9711462.3 4 June 1997 (04.06.97) GB</p> <p>(71) Applicant (for all designated States except US): LAWSON MARDON SUTTON LTD. [GB/GB]; Forest Works, Cox-moor Road, Sutton-in-Ashfield, Nottinghamshire NG17 5LH (GB).</p> <p>(72) Inventors; and</p> <p>(75) Inventors/Applicants (for US only): BAIRD-SMITH, Ian [GB/GB]; 6 Dunham Close, Southwell, Nottinghamshire NG25 0JU (GB). ZIEGLER, Andreas [DE/CH]; Braatstrasse 186, CH-8234 Stetten (CH). GEISLER, Reinhart [DE/DE]; Am Breitenstein 4, D-78244 Gottmadingen (DE). HAMMON, Werner [DE/DE]; Jakob-Barth-Strasse 12, D-78333 Stockach (DE).</p> <p>(74) Agent: ALUSUISSE TECHNOLOGY & MANAGEMENT AG; CH-8212 Neuhausen am Rheinfall (CH).</p>		<p>(81) Designated States: AU, BR, CA, JP, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>
<p>(54) Title: A CONTAINER CLOSURE</p> <div data-bbox="341 1144 1266 1732">  </div> <p>(57) Abstract</p> <p>The invention concerns a closure for a cylindrical can (10). The closure includes a flexible member (11) of the easy-open type secured across the open end of the can (10). A rigid, screw cap (22) is screwed over the thus sealed end of the can. An annular, resilient member (24) depending downwardly from the underside of the end wall of the cap (22), engages the membrane (11) in the vicinity of the end flange (18) of the can body (10), thereby strengthening the seal between the membrane (11) and the flange (18). This advantageously permits cooking of the contents of the can with the flexible membrane (11) in situ, thereby giving rise to a can having an easy-open end, the contents of which can be cooked and sterilized using conventional processing lines.</p>		

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A CONTAINER CLOSURE

This invention relates to container closures. In particular the invention concerns such closures known as "easy open ends".

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Easy open ends are typically provided in containers that are elongate and, in the unfilled state, open at at least one end. An example of such a container is a metal can.

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There are two main types of easy open end. One is made from relatively thick and rigid steel or aluminium, which incorporates a "score" or weakened annular region. This weakened region allows the centre part of the end to be removed, but has the disadvantages that the required opening force is relatively high, making it difficult for less dextrous people, and that the ruptured edge is sharp and may cause laceration injuries. The process to form the rivet by which an opening tab may be attached requires

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many drawing and forming steps, even above steps. Typically the thickness of steel easy open ends is 0.22 mm or greater, even up to 0.30 mm, depending on the diameter of the closure.

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An alternative easy open end typically comprises a flexible, frangible membrane usually of metal foil, or of a laminated material including a layer of metal foil, secured over the open end of a can after filling thereof with eg. a food product. Since the flexible membrane is easily peeled off the can end, it is easy for a user of the can to tear the membrane to gain access to the food product inside the can. The flexible membrane is then usually torn off the can and discarded. Some types of flexible membrane include

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pull tabs and weakened lines to assist the opening process.

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Where a flexible membrane is used there are a number of ways to secure it to the can body. It may be sealed to a ring of aluminium or tinplate or electrolytically chromium coated steel (ECCS), which has been coated with either a layer of flexible polymer such as polypropylene or with a layer of a lacquer which incorporates a quantity of fusible polymer such as polypropylene. To effect a seal the foil membrane (also coated with a layer of fusible polypropylene) is placed over the ring and heat is applied through tools above and below the membrane-ring components. This heat melts one or both of the polymer layers which are then sealed together on cooling. The ring is then attached to

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the can body by a conventional double seam. In this component the opening is achieved

- 2 -

by either breaking the polymer layer to metal adhesion or by breaking within the polymer layer.

5 An alternative method is to seal the flexible foil membrane directly to the can body, by again heating the membrane and can body until the polymer layers soften sufficiently to melt together and cool to form a homogeneous solid layer, which can then operate as above when opened. It is also possible (but not common) to use an adesive material to fix the foil on to the can.

10 Many food products are packed in cans in an uncooked or partially cooked state. On sealing of the cans in food production factories their contents are heated (eg. by steam or steam/air heating) to cook them completely and simultaneously sterilise the interiors of the cans. This process, which has been in widespread use for more than 150 years, allows the safe canning of food products at very high rates of production. However, it has been traditional to employ three piece cans for this process. Both ends of a filled
15 three piece can are substantially rigid. Hence it is necessary to use a can opening machine to open such a can. This is generally considerably slower than opening an easy open end. Also, many people find can opening machines difficult or impossible to use.

20 It is possible, and indeed is common, to use easy open ends for continuous mass production of canned food products, but these ends are of the more rigid type with relatively high thickness, as described above. What is not currently possible is to use foil sealed cans in a continuous steriliser, without the use of over-pressure to counterbalance the pressure generated inside the can.

25 It has not previously been possible to employ the flexible membrane-type easy open ends in the continuous mass production of cans the contents of which require cooking in situ. This is primarily because the heating process causes expansion of gases sealed within the cans, and causes further gases to evaporate from the food products, with the result that the seals between the flexible membranes and the can ends burst or, less desirably, leak
30 in a manner that is difficult to detect. Failures of the flexible membranes themselves (as contrasted with the seals) also occur.

One possible solution to these problems lies in the use of an overpressure cooker that is capable of equalising the pressures acting on both sides of the flexible membranes during
35 cooking. This apparatus is disadvantageous, however, since its heating chamber must be

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sealed and pressurised during the cooking process. Thus the overpressure cooker cannot be used for continuous mass production employing moving conveyor lines.

5 Thus there is a need for an easy open closure suitable for use in continuous mass production of food products.

10 US Patent No. 4,683,016 discloses an easy open end the rigid closure of which includes concentric, downwardly depending annular members that tension the flexible membrane. However, this arrangement only serves to promote a good seal between the container end and the flexible membrane before final curing of the adhesive therebetween. This results in a smooth and well sealed membrane, but would be unlikely to prevent bursting of the seal during cooking since by that stage the strength of the seal depends entirely on the properties of the adhesive material securing the flexible membrane on the container end.

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According to a first aspect of the invention there is provided a container closure for an open-ended container comprising:

- (i) a flexible membrane closing the open end of the container;
- (ii) a seal between the flexible membrane and the container; and
- 20 (iii) a rigid closure having a resiliently deformable member juxtaposed to the flexible membrane, the resiliently deformable member pressing the flexible membrane against the container in the vicinity of the seal, thereby reinforcing the seal sufficiently to withstand pressures generated on heating of the contents of the container.

25 This arrangement is advantageous because the resiliently deformable member (reacting against the rigid closure) continuously and evenly reinforces the seal while the rigid closure is mounted on the container. Furthermore, through judicious choice of the material of the resiliently deformable member, the reinforcing pressure applied to the seal may be arranged to increase as the pressure inside the can increases, since this increases
30 the force conferred by the flexible membrane on the resiliently deformable material. This is ideally suited to in situ cooking of the can contents, since the pressure within the can progressively increases for part of the cooking process.

According to a second aspect of the invention, there is provided a metal, plastic or composite can including a container closure as defined herein.

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This can advantageously allows the mass production of canned food products that are accessible via easy open ends.

- According to a third aspect of the invention, there is provided a method
- 5 of forming a container closure as defined herein, comprising the steps of:
- (i) securing a said flexible membrane on the open end of a said container neck by use of adhesives or heat-sealing, thereby forming a said seal;
 - (ii) engaging the cam and follower of a said rigid closure and the container neck with one another; and
 - 10 (iii) moving the rigid closure and the container neck relative to one another to cause relative movement between the cam and follower in the predetermined direction, thereby causing the resiliently deformable member to press the flexible membrane against the container in the vicinity of the seal sufficiently to maintain the seal against pressures generated in the container on heating of its contents.

- 15 This method is conveniently suited to the mass production of canned foodstuffs in existing food factories. The method obviates the need to use pressure cookers to cook food products in cans having easy open ends, and allows production of the filled, sealed cans to occur while the cans move along the conveyor lines of a continuous production
- 20 apparatus.

- According to a fourth aspect of the invention, there is provided a method of packaging a food product, comprising the steps of placing the food product in an open ended container; closing the open end of the container with a container closure as defined
- 25 herein; and heating the container and the food product therein, the container closure maintaining the seal between the flexible membrane and the container during such heating.

- According to a fifth aspect of the invention, there is provided a method of packaging a
- 30 food product comprising the steps of closing an open end of a container having two open ends with a closure as defined herein; placing a food product in the container; closing the other open end of the container by flanging a container end thereto; and heating the container and the food product therein, the container closure maintaining the seal between the flexible membrane and the container during such heating.
- 35 Further, advantageous features of the invention are defined in the dependent claims hereof.

- 5 -

There now follows a description of preferred embodiments of the invention, by way of example, with reference being made to the accompanying drawings in which:

Figure 1 is a vertically sectioned view of the end of a container and closure according to the invention;

5 Figure 2 is a partly-sectioned view showing the components of the Figure 1 closure before assembly;

Figure 3 shows a step in a preferred method of forming the container closure; and

10 Figure 4 shows an alternative form of closure according to the invention.

Referring to the drawings, there is shown an open ended container in the form of cylindrical metal can 10.

15 The open end of can 10 is closed by a flexible membrane 11 and a rigid cap 12, each of which is described in more detail below.

The body 13 of can 10 is manufactured in a generally conventional manner. Body 13 may be of the one-piece or two-piece types well known in the art of can making. Body
20 13 is a two-piece body in the embodiment shown.

A short distance from its open end, body 13 is necked inwardly at 14. Thus there is defined a parallel sided main body portion 13a of maximum diameter; and a further body portion 13b, proximate the open end of the can, of reduced diameter.

25 The necking (at 14) of the body 13 is defined by an inclined shoulder or chamfer extending about the periphery of can 13. Reduced diameter body portion 13b is substantially parallel sided and terminates in a further neck 16 defining a yet further reduced diameter portion 17.

30 Reduced diameter portion 17 is also substantially parallel sided, and terminates in an outwardly turned, annular flange 18 the outer diameter of which is substantially the same as that of body portion 13b.

35 The cylindrical walls of the body portions 13a, 13b and 17 are 20 substantially parallel to the longitudinal axis of the can 10.

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The annular surface of flange 18 remote from body portion 17 faces outwardly at the open end of the can, and is substantially perpendicular to the longitudinal axis of the can. Flexible membrane 11 is adhesively secured to flange 18 by means of eg. an annular strip of heat seal material that cures on heating (typically up to 180°C for 1 second) thereof.

5 The heat sealing tools 150,151 are shown in Figure 3. The step of securing the flexible membrane to the open end of the container neck may utilize a heat-sealing method such as heat contact, ultra sonic, induction or hot air.

10 The radial dimension x of the flange 18 is, typically, 2 to 4mm in length. The width of the annular band of adhesive material between membrane 11 and flange 18 is of a similar dimension.

In practice the heat seal lacquer material extends over the entire interior surface of the can, as shown at 160 in Figure 3. The lacquer may be eg. a polypropylene or polyethylene extrusion coating, or could be a PET film.

15 The membrane 11 may be eg. a metal (eg. aluminium or steel) foil, or a laminated, flexible, composite material such as a layer of metal foil bonded to a layer of paper or a plastic film with a functional barrier layer. In any event, the lower surface 11a of flexible member 11 is substantially inert, in the sense that it does not contaminate or react with the contents of container 10. The upper surface 11b of flexible membrane 11 may be printed with advertising material or user instructions.

20 Body portion 13b has disposed at intervals about its outer periphery a series of cam members in the form of threads 19. Each thread in the embodiment shown lies at the same angle as the adjacent threads, and extends over the same length. In preferred embodiments this length is a few degrees (e.g. 5 - 10°) of arc. As illustrated schematically in Figure 1, each thread 19 is formed as an embossment that is slightly proud of the surface of body portion 13b. The embossments may be formed in a conventional manner eg. by means of an expanding, rotatable tool insertable through the open neck of can 10 during manufacture thereof, to deform the material of wall portion 13b as desired.

30 The closure of the open end of can 10 includes a rigid cap 12 comprising 30 a circular disc 21 having a cylindrical, annular skirt 22 depending downwardly therefrom.

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Annular skirt 22 includes on its outer surface a series of recesses of substantially the same size, angle and length as the threads 19 formed on body portion 13. The recesses 23 appear as embossments on the inner surface of skirt 22. Hence they constitute cam followers in the form of threads complementary to the threads 19. Thus the cap 12, which may be manufactured eg. by deep drawing of a slug of metal using a *per se* known process, may be screwed onto the end of can 10 through cooperation of the threads 19 and recesses 23.

When cap 12 is screwed onto the open end of can 10 as aforesaid, the angles of the threads relative to the can 10 causes disc 21 to be driven towards membrane 11 on tightening of cap 12.

The underside of disc 21 has adjacent its outermost circumference an annular member 24 secured thereto so as to depend downwardly from the underside of disc 21.

Annular member 24 is formed of a resiliently deformable material, such as an expanded foam, a rubber based formulation, a PVC plastisol or a similar material. It is secured to the underside of disc 21 by virtue of its formation there (eg. by moulding or injection) or, possibly, by adhesive fixing in the cap 12 of a pre-formed sealing ring 24.

As cap 12 is tightened onto can 10, annular member 24 engages membrane 11.

Annular member 24 is located and dimensioned to sandwich a portion of membrane 11 against flange 18, in the vicinity of the adhesive material between membrane 11 and flange 18. Thus on tightening of cap 12, resilient, annular member 24 presses membrane 11 into tight, sealing contact with flange 18. This seal is capable of withstanding pressures developed within the can 10 during cooking of food products therein.

Furthermore, cooking of food products in the can 10 preferably occurs with the cap 12 in the position shown in Figure 1. In this position, the annular member 24 continues to press down on the seal between membrane 11 and flange 18, thereby providing additional reinforcing of the seal.

In the position shown in Figure 1, the gap 25 between membrane 11 and disc 21 is of the order of 1 - 6 mm. Thus the stretching of membrane 11 that occurs during cooking of food products in can 10 is accommodated by expansion of membrane 11 towards disc 21

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that is, as indicated, rigid. Thus the gas pressure within the can is reduced compared with that encountered in conventional cans.

5 A preferred method of packing a food product in accordance with the invention includes placing food products in an open ended can 10 one end 27 of which is sealed (by virtue of manufacture of the can body as a twopiece body sealed at one end by a closure according to the invention. If appropriate, a suitable modified atmosphere may be added above the level of the food product in the can 10 by a conventional apparatus; and then a conventional can end may be secured in a *per se* known manner by a "flanger" having, ie.
10 a double seaming machine.

Before cooking of the food products, and preferably before the food products are placed in the can, a cap 12 is screwed onto the threads 19 of 30 the closure of the invention again by machine or by hand as appropriate and tightened down onto the end of can 10 until annular member 24 presses membrane 11 against flange 18 with a predetermined
15 pressure. The moment prior to contact between the components is shown in Figure 3. The predetermined pressure may be achieved eg. by sensing the torque necessary to rotate cap 12 onto the threads 19.

Thereafter, the can 10 is passed to a suitable cooking apparatus such as a steam,
20 steam/air or water cascade cooker that cooks the food products within the can 10. As is well known, this process kills bacteria in the can rendering the food products safe for long term storage. It also temporarily inoreases gas pressure in the can, primarily by virtue of expansion of any gas between the food material and the can body; and also through migration of gas molecules from the food products as the food product
25 temperature increases.

The action of annular member 24 ensures that the peripheral seal of membrane 11 is strong enough to withstand the additional pressures generated during cooking. The presence of disc 21 prevents rupture of membrane 11 at locations spaced from flange 18.
30 In some embodiments the heating process may cause the material of member 24 to change, thereby allowing easy removal of cap 12.

After cooling of the can 10 it may be distributed. A user of the can may then unscrew
35 cap 12 to reveal the membrane 11. Membrane 11 may then be peeled off in order to gain access to the food product within the can.

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After peeling membrane 11 may be removed and discarded. Subsequent reclosing of can 10 using cap 12 causes the annular member 24 to engage either flange 18 or an annular portion of membrane 11 remaining adhered thereto, to provide a short to medium term resealing facility thereby extending the life of the food products after opening of the can.

5 Figure 2 shows an optional pull-off tab 26, formed integrally with membrane 11, that may be provided to assist the opening of the membrane s 11. Since the hinge securing the tab 26 is of the same material and thickness as membrane 11, lifting of tab 26 is facilitated.

10 Thus the invention advantageously provides an apparatus and a method by means of which cooked food products may be provided in metal or other o cans having easy open ends.

15 Furthermore, the process readily lends itself to automation using high speed can making machinery capable of forming cans at rates of perhaps 300 per minute or greater. The quality and integrity of the heat sealing operation can readily be tested and verified.

20 The neck 14 in the can body 13 provides a neat appearance to the can when cap 12 is secured thereto, since the skirt 22 depending downwardly from disc 21 is of the same diameter as body portion 13a. The neck 14 therefore provides for a generally flush appearance to the can end.

Alternatively the cap diameter can be made the same as the seam diameter on the opposing end of the can, so that the can will roll satisfactorily during existing processes.
25 This is shown schematically at 130 in Figure 4.

Figure 4 also shows use of an optional, rippled form 121 of the upper wall of cap 12. This assists in resisting the cooking pressure in *a per se* known manner.

30 Figure 3 shows the membrane 11 in its preferred form, ie. an upper, metal foil layer 11b having its lower surface coated with eg. polypropylene 11a.

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CLAIMS

1. A container closure for an open-ended container comprising:
 - (i) a flexible membrane closing the open end of the container;
 - (ii) a seal between the flexible membrane and the container; and
 - 5 (iii) a rigid closure having a resiliently deformable member juxtaposed to the flexible membrane, the resiliently deformable member pressing the flexible membrane against the container in the vicinity of the seal, thereby reinforcing the seal sufficiently to withstand pressures generated on heating of the contents of the container.
- 10 2. A container closure according to Claim 1 wherein the container and the rigid member include a respective cam and follower, relative movement between the cam and follower in a predetermined direction causing the rigid cap and the container neck to approach one another, thereby increasing the pressure exerted by the resiliently deformable member on the
- 15 flexible membrane.
3. A container closure according to Claim 2 wherein the cam and follower include co-operating screw threads formed respectively on the container and the rigid closure.
- 20 4. A container closure according to any preceding claim wherein the container includes a neck having an annular flange defining the said seal, the resilient member being substantially congruent with the flange whereby the resilient member presses the flexible membrane against the flange.
5. A container closure according to Claim 2 or any claim dependent therefrom,
- 25 wherein the rigid closure includes a laminar member and an annular skirt depending downwardly therefrom, the cam or the follower being secured on an inner wall of the skirt.
6. A container closure according to Claim 5 wherein the laminar member is a
- 30 circular disc, the skirt depending from the outer periphery thereof.
7. A container closure according to Claim 5 or Claim 6 wherein the laminar member is spaced from the flexible membrane by a distance less than the maximum possible extension of the flexible member towards the laminar member.
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8. A container closure according to any preceding claim wherein the resiliently deformable member comprises a foamed material secured to the rigid closure.

9. A container closure according to any preceding claim wherein the flexible membrane comprises a metal foil or a plastic film with a functional barrier layer adhesively secured on the container neck.

10. A container closure according to any of Claims 4 to 9 wherein the container neck is generally cylindrical.

11. A container closure according to any preceding claim including a lifting tab hingably secured to the flexible membrane by the same material as that of the flexible membrane.

12. A metal, plastic or composite can including a container closure according to any preceding claim.

13. A can according to Claim 12 wherein the rigid cap supports the body of the can in a radial direction.

14. A method of forming a container closure according to any preceding claim, comprising the steps of:

(i) securing a said flexible membrane on the open end of a said container neck by use of adhesives or heat-sealing, thereby forming a said seal;

(ii) engaging the cam and follower of a said rigid closure and the container neck with one another; and

(iii) moving the rigid closure and the container neck relative to one another to cause relative movement between the cam and follower in the predetermined direction, thereby causing the resiliently deformable member to press the flexible membrane against the container in the vicinity of the seal sufficiently to maintain the seal against pressures generated in the container on heating of its contents.

15. A method according to Claim 14 wherein the step of securing the said flexible membrane on the open end of the said container neck by use of a heat-sealing method such as heat contact, ultrasonic, induction or hot air.

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16. A method according to Claim 14 wherein the step of moving the rigid closure and the container neck relative to one another includes rotating the rigid closure and the container neck relative to one another.

17. A method according to Claim 14 or Claim 16 wherein the step of adhesively
5 securing the flexible membrane on the open end of the container neck includes the sub steps of applying

adhesive material to the flexible membrane and/or the container neck; engaging the flexible membrane and the container neck with one another to define the seal; and curing
10 the adhesive material

18. A method according to Claim 17 wherein the sub step of curing the adhesive material includes heating thereof.

19. A method of packaging a food product, comprising the steps of placing the food
15 product in an open ended container; closing the open end of the container with a container closure according to any of Claims 1 to 10; and heating the container and the food product therein, the container closure maintaining the seal between the flexible membrane and the container during such heating.

20. A method of packaging a food product comprising the steps of closing an open
20 end of a container having two open ends with a closure according to any of Claims 1 to 10; placing a food product in the container; closing the other open end of the container by flanging a container end thereto; and heating the container and the food product therein, the container closure maintaining the seal between the flexible membrane and the
25 container during such heating.

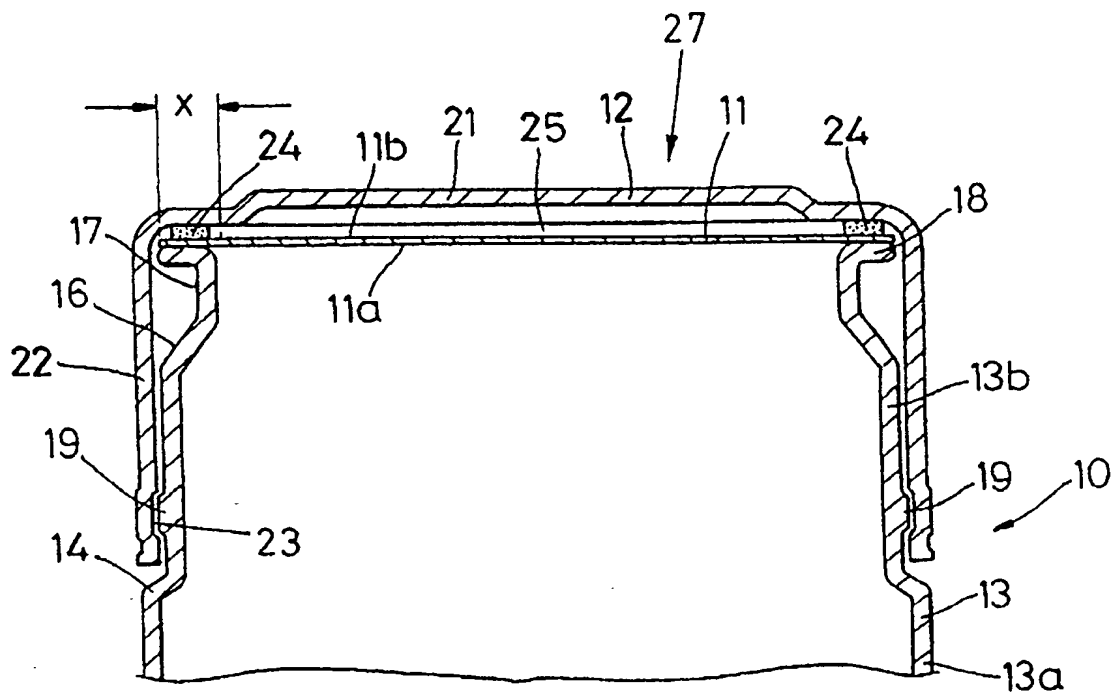
21. A method according to Claim 19 or Claim 20 wherein the step of heating includes cooking the food product in the container.

22. A container closure generally as herein described, with reference to or as
30 illustrated in the accompanying drawings.

23. Methods generally as herein described, with reference to or as illustrated in the accompanying drawings.

24. A can generally as herein described, with reference to or as illustrated in the ac-
35 companying drawings.

1/3

*Fig. 1*

2/3

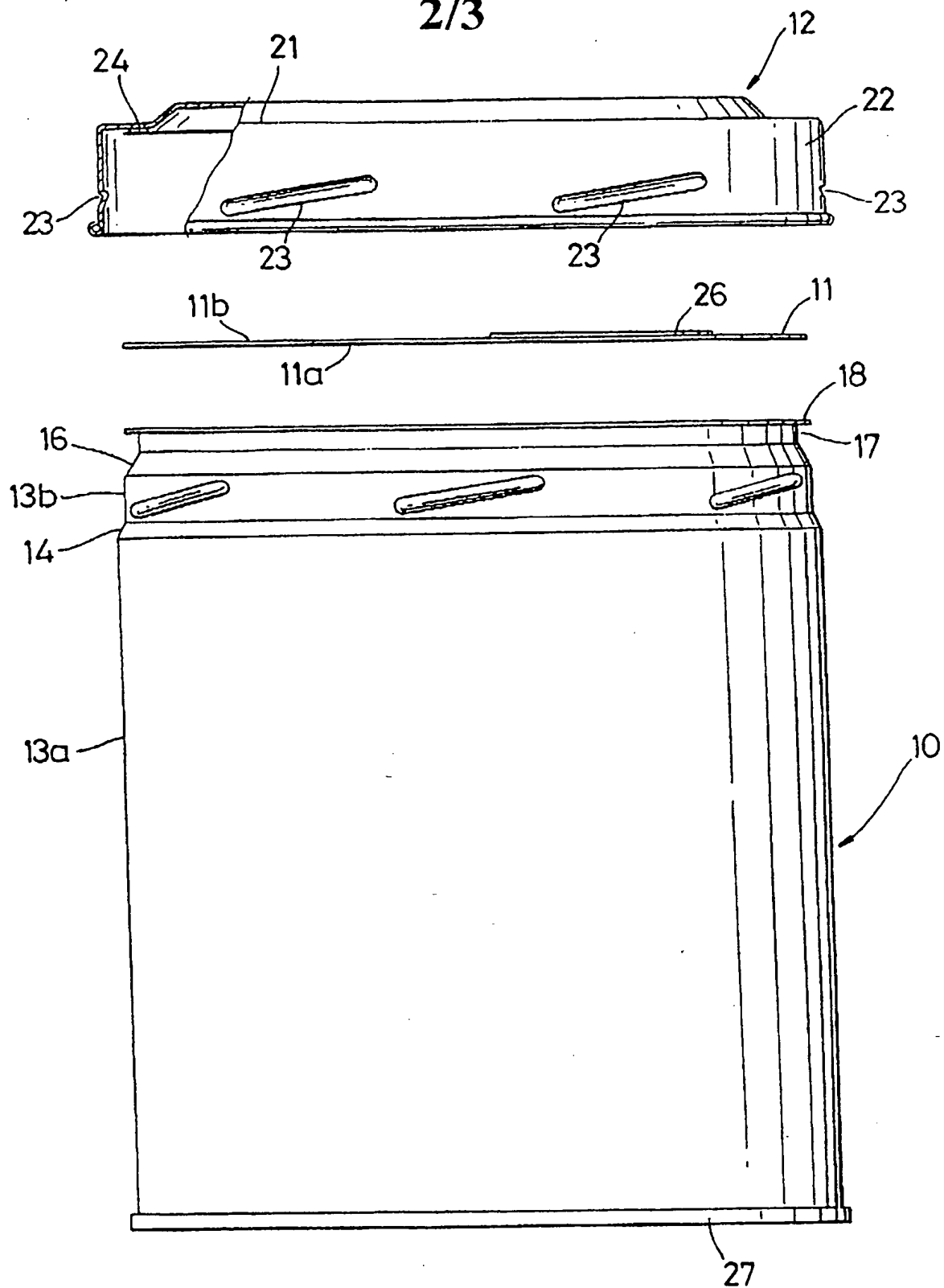
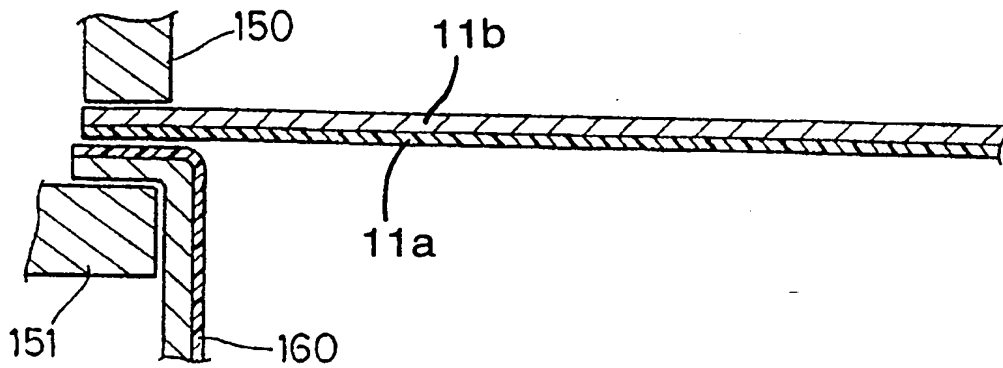
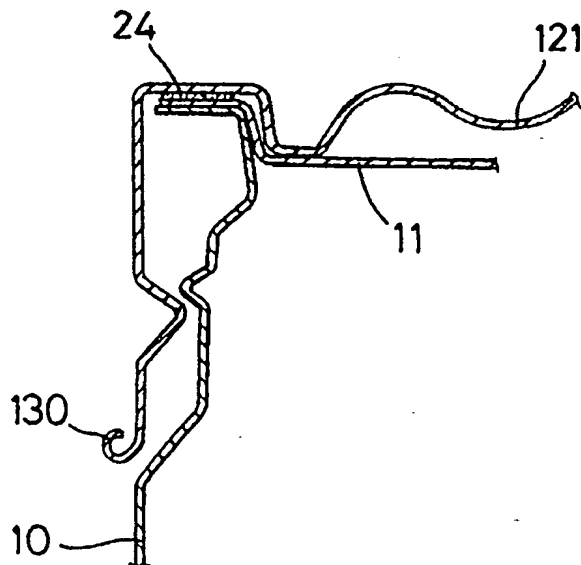


Fig. 2

3/3

*Fig. 3**Fig 4*

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 98/00825

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B65D51/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 018, no. 589 (M-1701), 10 November 1994 & JP 06 219464 A (MITSUBISHI PLASTICS IND LTD; OTHERS: 01), 9 August 1994 see abstract	1-7, 9-16
A	---	20
X	US 3 833 142 A (OWEN) 3 September 1974 see column 2, line 4 - column 4, line 16; figures 1-3	1-3, 5-7, 9-16
X	---	
X	DE 840 078 C (BUSE) 26 May 1952 see page 3, line 3 - line 30; figure 2	1
A	---	
A	GB 1 569 106 A (METAL BOX) 11 June 1980 see page 1, line 55 - page 2, line 97; figures 1-4	19, 20
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

21 August 1998

Date of mailing of the international search report

29.09.98

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 98/00825

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 072 131 A (SWISS ALUMINIUM) 30 September 1981 see figures 1-3 ---	1
A	FR 2 604 976 A (CARNAUD EMBALLAGE) 15 April 1988 see figures 1-5 ---	1
A	US 4 683 016 A (DUTT) 28 July 1987 cited in the application -----	

INTERNATIONAL SEARCH REPORT

national application No.

PCT/IB 98/ 00825

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 22-24
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
PCT Rule 6.2 (a)
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IB 98/00825

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3833142	A	03-09-1974	NONE	
DE 840078	C		NONE	
GB 1569106	A	11-06-1980	IN 145948 A ZA 7606668 A	20-01-1979 26-10-1977
GB 2072131	A	30-09-1981	CH 643502 A DE 3017042 A FR 2479153 A US 4328905 A	15-06-1984 01-10-1981 02-10-1981 11-05-1982
FR 2604976	A	15-04-1988	NONE	
US 4683016	A	28-07-1987	NONE	

PCT

REC'D 22 SEP 1999

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TCBG-HB/vR 2164		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) FOR FURTHER ACTION	
International application No. PCT/IB98/00825	International filing date (day/month/year) 28/05/1998	Priority date (day/month/year) 04/06/1997	
International Patent Classification (IPC) or national classification and IPC B65D51/20			
Applicant LAWSON MARDON SUTTON LTD. et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 17 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 24/12/1998	Date of completion of this report 21.09.99
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. (+31-70) 340-2040 Tx: 31 651 epo nl Fax: (+31-70) 340-3016	Authorized officer Berrington, N  Telephone No. (+31-70)-340

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB98/00825

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-13 as received on 07/05/1999 with letter of 06/05/1999

Claims, No.:

1-21 as received on 07/05/1999 with letter of 06/05/1999

Drawings, sheets:

1/3-3/3 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☒ the claims, Nos.: 22-24
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IB98/00825

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	8,9,11,17,18,20,21
	No:	Claims	1-7,10,12-16,19
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-21
Industrial applicability (IA)	Yes:	Claims	1-21
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re V.

- V.1.1 Document JP-A-06219464 (see abstract and figure) discloses a container assembly comprising an open-ended container (1) and a container closure therefor including:
- (i) a flexible membrane (3) closing the open end of the container (1);
 - (ii) a seal between the flexible membrane (3) and the container (1);
 - (iii) a rigid closure (5) having a resiliently deformable member (6) juxtaposed to the flexible membrane (3), the resiliently deformable member (6) pressing the flexible membrane (3) against the container (1) in the vicinity of the seal, thereby reinforcing the seal sufficiently to withstand pressures generated on heating the contents of the container (1).

The expression "plastic sheet", especially since this is to be peeled off, must be considered as a flexible membrane in the same sense as that of the current application. The element "6" is used as a sealing element; in order to effectively seal the container, this element has to be resiliently deformable. Thus, the subject-matter of claim 1 is not novel.

Moreover, document DE-C-840078 discloses all the technical characteristics of claim 1 even if the application is different (i.e. the product is not intended to be heated in the container in this document). Thus, this document would also attack claim 1 on the grounds of lack of novelty.

- V.1.2 Dependent claims 2-13 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step, since the combination of features of these claims are either not novel or the additional features of these claims are known per se or do not extend beyond the general knowledge and abilities of the skilled man, see for example:

claims 2-7: JP-A-06219464 (figure)

claim 8: although JP-A-06219464 does not disclose that the resiliently deformable member comprises a foamed material, this is an obvious choice of material for this element.

claim 9: GB-A-2072131 (page 1, lines 42-80 and figures 1-3) in combination with JP-A-06219464.

claim 10: JP-A-06219464 (figure)

claim 11: GB-A-2072131 (page 1, lines 113-119 and figure 1) in combination with JP-A-06219464.

claims 12,13: JP-A-06219464 (figure).

Even if the claims had been limited to metal cans, such a limitation would not have led to an inventive step since document GB-A-2072131 already indicates such a possibility and the replacement of the container disclosed in JP-A-06219464 by the metal can shown in GB-A-2072131 would lie well within the abilities of the skilled man.

- V.2.1 Document JP-A-06219464 discloses a method of forming a container assembly according to claim 2 comprising the steps of:
- (i) securing a flexible membrane (3) on the open end of a container neck by use of heat-sealing, thereby forming a seal;
 - (ii) engaging the cam and follower of a rigid closure (5) and the container neck with one another; and
 - (iii) moving the rigid closure (5) and the container neck relative to one another to cause relative movement between the cam and follower in the predetermined direction, thereby causing the resiliently deformable member (6) to press the flexible membrane (3) against the container (1) in the vicinity of the seal sufficiently to maintain the seal against pressures generated in the container on heating of its contents.

Thus, the subject-matter of claim 14 is lacking in novelty.

- V.2.2 Dependent claims 15-18 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step, since the combination of features of these claims are either not novel or the additional features of these claims are known per se or do not extend beyond the general knowledge and abilities of the skilled man, see for example:

claims 15,16: JP-A-06219464 (abstract and figure)

claims 17, 18: Since the inner lid (3) in JP-A-0621494 is applied to the container by means of area (4) by means of heat sealing, it would be evident to the skilled man to cure the adhesive area (4) in order to obtain such a seal.

- V.3.1 Document JP-A-06219464 (see abstract and figure) discloses a method of packaging a food product (9) comprising the steps of placing the food in an open ended container (1), closing the open end of the container (1) with a container assembly according to claim 1, and heating the container (1) and the food product (9) therein, the container closure maintaining the seal between the flexible membrane (3) and the container (1) during such heating.

Thus, the subject-matter of claim 19 is anticipated by JP-A-06219464.

- V.3.2 Dependent claims 20 and 21 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step, since the additional features of these claims are either known per se or do not extend beyond the general knowledge and abilities of the skilled man, see for example:

claim 20: GB-A-1569106 discloses the use of a container having two open ends with a closure similar to that of claim 1 whereby the container is filled at the opposite end. The replacement of the double closure (diaphragm + slip lid) of GB-A-1569106 by the closure disclosed in JP-A-06219464 would be evident to the skilled man.

claim 21: Although JP-A-06219464 is used for the heat sterilization of cooked food, it is well known in the art (as mentioned in the application) to cook food directly in the container. Thus, this slight modification cannot be considered to involve an inventive step.

Re VII.

- VII.1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB98/00825

art disclosed in the document JP-A-06219464 is not mentioned in the description, nor is this document identified therein.

- VII.2 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
- VII.3 Independent claim 1 is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document JP 06219464A) being placed in a preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

Re VIII.

- VIII.1 The following typographical errors have been identified in the application:
- I) claim 9 should read "A container assembly according to..." rather than "A container according to...";
 - ii) claim 13 should read "rigid cap supports the..." rather than "rigid cap supports of the...";
 - iii) a space should have been inserted between the term "membrane" and reference numeral "11" on page 8, line 18 and page 12, line 19.

A CONTAINER ASSEMBLY

This invention relates to container assemblies in particular the invention concerns such assemblies including closures known as "easy open ends".

5

Easy open ends are typically provided in containers that are elongate and, in the unfilled state, open at at least one end. An example of such a container is a metal can.

10 There are two main types of easy open end. One is made from relatively thick and rigid steel or aluminium, which incorporates a "score" or weakened annular region. This weakened region allows the centre part of the end to be removed, but has the disadvantages that the required opening force is relatively high, making it difficult for less dextrous people to
15 open, and that the ruptured edge is sharp and may cause laceration injuries. The process to form the rivet by which an opening tab may be attached requires many drawing and forming steps. Typically the thickness of steel easy open ends is 0.22 mm or greater, even up to 0.30mm, depending on the diameter of the closure.

20

An alternative easy open end typically comprises a flexible, frangible membrane usually of metal foil, or of a laminated material including a layer of metal foil, secured over the open end of a can after filling thereof with eg. a food product. Since the flexible membrane is easily peeled off
25 the can end, it is easy for a user of the can to tear the membrane to gain access to the food product inside the can. The flexible membrane is then usually torn off the can and discarded. Some types of flexible membrane include pull tabs and weakened lines to assist the opening process.

Where a flexible membrane is used there are a number of ways to secure it to the can body. It may be sealed to a ring of aluminium or tinplate or electrolytically chromium coated steel (ECCS), which has been coated with either a layer of flexible polymer such as polypropylene or
5 with a layer of a lacquer which incorporates a quantity of fusible polymer such as polypropylene. To effect a seal the foil membrane (also coated with a layer of fusible polypropylene) is placed over the ring and heat is applied through tools above and below the membrane-ring components. This heat melts one or both of the polymer layers which are then sealed
10 together on cooling. The ring is then attached to the can body by a conventional double seam. In this component the opening is achieved by either breaking the polymer layer to metal adhesion or by breaking within the polymer layer.

15 An alternative method is to seal the flexible foil membrane directly to the can body, by again heating the membrane and can body until the polymer layers soften sufficiently to melt together and cool to form a homogeneous solid layer, which can then operate as above when opened. It is also possible (but not common) to use an adhesive material to fix the foil on to
20 the can.

Many food products are packed in cans in an uncooked or partially cooked state. On sealing of the cans in food production factories their contents are heated (eg. by steam or steam/air heating) to cook the completely and
25 simultaneously sterilise the interiors of the cans. This process, which has been in widespread use for more than 150 years, allows the safe canning of food products at very high rates of production. However, it has been traditional to employ three piece cans for this process. Both ends of a filled three piece can are substantially rigid. Hence it is necessary to use

a can opening machine to open such a can. This is generally considerably slower than opening an easy open end. Also, many people find can opening machines difficult or impossible to use.

- 5 It is possible, and indeed is common, to use easy open ends for continuous mass production of canned food products, but these ends are of the more rigid type with relatively high thickness, as described above. What is not currently possible is to use foil sealed cans in a continuous steriliser, without the use of over-pressure to counterbalance the pressure generated
10 inside the can.

It has not previously been possible to employ the flexible membrane-type easy open ends in the continuous mass production of cans the contents of which require cooking *in situ*. This is primarily because the heating
15 process causes expansion of gases sealed within the cans, and causes further gases to evaporate from the food products, with the result that the seals between the flexible membranes and the can ends burst or, less desirably, leak in a manner that is difficult to detect. Failures of the flexible membranes themselves (as contrasted with the seals) also occur.

20 One possible solution to these problems lies in the use of an overpressure cooker that is capable of equalising the pressures acting on both sides of the - flexible - membranes during cooking. This apparatus is disadvantageous, however, since its heating chamber must be sealed and
25 pressurised during the cooking process. Thus the overpressure cooker cannot be used for continuous mass production employing moving conveyor lines.

Thus there is a need for an easy open closure suitable for use in continuous mass production of food products.

US Patent No. 4,683,016 discloses an easy open end the rigid closure of which includes concentric, downwardly depending annular members that
5 tension the flexible membrane. However, this arrangement only serves to promote a good seal between the container end and the flexible membrane before final curing of the adhesive therebetween. This results in a smooth and well sealed membrane, but would be unlikely to prevent bursting of
10 the seal during cooking since by that stage the strength of the seal depends entirely on the properties of the adhesive material securing the flexible membrane on the container end.

According to a first aspect of the invention there is provided a container
15 assembly comprising an open-ended container and a closure system therefor, including:-

- (i) a flexible membrane closing the open end of the container;
- (ii) a seal between the flexible membrane and the container; and
- (iii) a rigid closure mounted on the container having a resiliently
20 deformable member juxtaposed to the flexible membrane, the resiliently deformable member pressing the flexible membrane against the container in the vicinity of the seal, thereby reinforcing the seal sufficiently to withstand pressures generated on heating of the contents of the container.

25 This assembly is advantageous because the resiliently deformable member (reacting against the rigid closure) continuously and evenly reinforces the seal while the rigid closure is mounted on the container. Furthermore, through judicious choice of the material of the resiliently deformable member, the reinforcing pressure applied to the seal may be arranged to

increase as the pressure inside the can increases, since this increases the force conferred by the flexible membrane on the resiliently deformable material. This is ideally suited to *in situ* cooking of the can contents, since the pressure within the can progressively increases for part of the
5 cooking process.

Preferably a container assembly in accordance with the invention includes a container which is a metal, plastic or composite can.

10 This can advantageously allows the mass production of canned food products that are accessible via easy open ends.

According to a second aspect of the invention, there is provided a method of forming a container assembly in accordance with the invention,
15 comprising the steps of:

(i) securing a flexible membrane on the open end of the container by use of adhesives or heat-sealing, thereby forming a seal;

(ii) engaging the cam and follower of a rigid closure and the container with one another; and

20 (iii) moving the rigid closure and the container relative to one another to cause relative movement between the cam and follower in the predetermined direction, thereby causing the resiliently deformable member to press the flexible membrane against the container in the vicinity of the seal sufficiently to maintain the seal against pressures
25 generated in the container on heating of its contents.

This method is conveniently suited to the mass production of canned food stuffs in existing food factories. The method obviates the need to use pressure cookers to cook food products in cans having easy open ends,

and allows production of the filled, sealed cans to occur while the cans move along the conveyor lines of a continuous production apparatus.

According to a third aspect of the invention, there is provided a method of
5 packaging a food product, comprising the steps of placing the food product in an open ended container; closing the open end of the container with a closure to provide an assembly in accordance with the invention and heating the container assembly and the food product therein, the container closure system; maintaining the seal between the flexible
10 membrane and the container during such heating.

According to a fourth aspect of the invention, there is provided a method of packaging a food product comprising the steps of closing an open end of a container having two open ends with a closure to provide a container
15 assembly in accordance with the invention placing a food product in the container; closing the other open end of the container by flanging a container end thereto; and heating the container and the food product therein, the container closure system maintaining the seal between the flexible membrane and the container during such heating.

20

Further, advantageous features of the invention are defined in the dependent claims hereof.

There now follows a description of preferred embodiments of the
25 invention, by way of example, with reference being made to the accompanying drawings in which:

Figure 1 is a vertically sectioned view of the end of a container assembly comprising a container and closure according to the invention;

Figure 2 is a partly-sectioned view showing the components of the

Figure 1 container-assembly;

Figure 3 shows a step in a preferred method of forming the container assembly; and

Figure 4 shows an alternative form of container assembly according
5 to the invention.

Referring to the drawings, there is shown an open ended container in the form of cylindrical metal can 10.

10 The open end of can 10 is closed by a flexible membrane 11 and a rigid cap 12, each of which is described in more detail below.

The body 13 of can 10 is manufactured in a generally conventional manner. Body 13 may be of the one-piece or two-piece types well known
15 in the art of can making. Body 13 is a two-piece body in the embodiment shown.

A short distance from its open end, body 13 is necked inwardly at 14. Thus there is defined a parallel sided main body portion 13a of maximum
20 diameter; and a further body portion 13b, proximate the open end of the can, of reduced diameter.

The necking (at 14) of the body 13 is defined by an inclined shoulder or chamfer extending about the periphery of can 13. Reduced diameter body
25 portion 13b is substantially parallel sided and terminates in a further neck 16 defining a yet further reduced diameter portion 17.

Reduced diameter portion 17 is also substantially parallel sided, and terminates in an outwardly turned, annular flange 18 the outer diameter of which is substantially the same as that of body portion 13b.

- 5 The cylindrical walls of the body portion portions 13a, 13b and 17 are substantially parallel to the longitudinal axis of the can 10.

The annular surface of flange 18 remote from body portion 17 faces outwardly at the open end of the can, and is substantially perpendicular to
10 the longitudinal axis of the can. Flexible membrane 11 is adhesively secured to flange 18 by means of eg. an annular strip of heat seal material that cures on heating (typically up to 180°C for 1 second) thereof. The heat sealing tools 150,151 are shown in Figure 3. The step of securing the flexible membrane to the open end of the container neck may utilize a
15 heat-sealing method such as heat contact, ultra sonic, induction or hot air.

The radial dimension x of the flange 18 is, typically, 2 to 4mm in length. The width of the annular band of adhesive material between membrane 11 and flange 18 is of a similar dimension.

20

In practice the heat seal lacquer material extends over the entire interior surface of the can, as shown at 160 in Figure 3. The lacquer may be eg. a polypropylene or polyethylene extrusion coating, or could be a PET film.

- 25 The membrane 11 may be eg. a metal (eg. aluminum or steel) foil, or a laminated, flexible, composite material such as a layer of metal foil bonded to a layer of paper or a plastic film with a functional barrier layer. In any event, the lower surface 11 a of flexible member 11 is substantially inert, in the sense that it does not contaminate or react with the contents of

container 10. The upper surface 11b of flexible membrane 11 may be printed with advertising material or user instructions.

Body portion 13b has disposed at intervals about its outer periphery a series of cam members in the form of threads 19. Each thread in the embodiment shown lies at the same angle as the adjacent threads, and extends over the same length. In preferred embodiments this length is a few degrees (e.g. 5 - 10°) of arc. As illustrated schematically in Figure 1, each thread 19 is formed as an embossment that is slightly proud of the surface of body portion 13b. The embossments may be formed in a conventional manner eg. by means of an expanding, rotatable tool insertable through the open neck of can 10 during manufacture thereof, to deform the material of wall portion 13b as desired.

The closure of the open end of can 10 includes a rigid cap 12 comprising a circular disc 21 having a cylindrical, annular skirt 22 depending downwardly therefrom.

Annular skirt 22 includes on its outer surface a series of recesses of substantially the same size, angle and length as the threads 19 formed on body portion 13. The recesses 23 appear as embossments on the inner surface of skirt 22. Hence they constitute cam followers in the form of threads complementary to the threads 19. Thus the cap 12, which may be manufactured eg. by deep drawing of a slug of metal using a *per se* known process, may be screwed onto the end of can 10 through cooperation of the threads 19 and recesses 23.

When cap 12 is screwed onto the open end of can 10 as aforesaid, the angles of the threads relative to the can 10 cause disc 21 to be driven towards membrane 11 on tightening of cap 12.

- 5 The underside of disc 21 has adjacent its outermost circumference an annular member 24 secured thereto so as to depend downwardly from the underside of disc 21.

Annular member 24 is formed of a resiliently deformable material, such
10 as an expanded foam, a rubber based formulation, a PVC plastisol or a similar material. It is secured to the underside of disc 21 by virtue of its formation there (eg. by moulding or injection) or, possibly, by adhesive fixing in the cap 12 of a pre-formed sealing ring 24.

- 15 As cap 12 is tightened onto can 10, annular member 24 engages membrane 11.

Annular member 24 is located and dimensioned to sandwich a portion of membrane 11 against flange 18, in the vicinity of the adhesive material
20 between membrane 11 and flange 18. Thus on tightening of cap 12, resilient, annular member 24 presses membrane 11 into tight, sealing contact with flange 18. This seal is capable of withstanding pressures developed within the can 10 during cooking of food products therein.

- 25 Furthermore, cooking of food products in the can 10 preferably occurs with the cap 12 in the position shown in Figure 1. In this position, the annular member 24 continues to press down on the seal between membrane 11 and flange 18, thereby providing additional reinforcing of the seal.

In the position shown in Figure 1, the gap 25 between membrane 11 and disc 21 is of the order of 1 - 6 mm. Thus the stretching of membrane 11 that occurs during cooking of food products in can 10 is accommodated by expansion of membrane 11 towards disc 21 that is, as indicated, rigid. Thus the gas pressure within the can is reduced compared with that encountered in conventional cans.

A preferred method of packing a food product in accordance with the invention includes placing food products in an open ended can 10 one end 27 of which is sealed (by virtue of manufacture of the can body as a two-piece body sealed at one end) by a closure to provide a container assembly according to the invention. If appropriate, a suitable modified atmosphere may be added above the level of the food product in the can 10 by a conventional apparatus; and then a conventional can end may be secured in a *per se* known manner by a "flanger", ie a double seaming machine.

Before cooking of the food products, and preferably before the food products are placed in the can, a cap 12 is screwed onto the threads 19 of 30 the closure of the invention again by machine or by hand as appropriate and tightened down onto the end of can 10 until annular member 24 presses membrane 11 against flange 18 with a predetermined pressure. The moment prior to contact between the components is shown in Figure 3. The predetermined pressure may be achieved eg. by sensing the torque necessary to rotate cap 12 onto the threads 19.

- Thereafter, the can 10 is passed to a suitable cooking apparatus such as a steam, steam/air or water cascade cooker that cooks the food products within the can 10. As is well known, this process kills bacteria in the can rendering the food products safe for long term storage. It also
- 5 temporarily increases gas pressure in the can, primarily by virtue of expansion of any gas between the food material and the can body; and also through migration of gas molecules from the food products as the food product temperature increases.
- 10 The action of annular member 24 ensures that the peripheral seal of membrane 11 is strong enough to withstand the additional pressures generated during cooking. The presence of disc 21 prevents rupture of membrane 11 at locations spaced from flange 18.
- 15 In some embodiments the heating process may cause the material of member 24 to change, thereby allowing easy removal of cap 12.

After cooling of the can 10 it may be distributed. A user of the can may then unscrew cap 12 to reveal the membrane 11. Membrane 11 may then

20 be peeled off in order to gain access to the food product within the can.

After peeling membrane 11 may be removed and discarded. Subsequent reclosing of can 10 using cap 12 causes the annular member 24 to engage either flange 18 or an annular portion of membrane 11 remaining adhered

25 thereto, to provide a short to medium term resealing facility thereby extending the life of the food products after opening of the can. Figure 2 shows an optional pull-off tab 26, formed integrally with membrane 11, that may be provided to assist the opening of the membrane 11. Since the

hinge securing the tab 26 is of the same material and thickness as membrane 11, lifting of tab 26 is facilitated.

Thus the invention advantageously provides an apparatus and a method by means of which cooked food products may be provided in metal or other
5 cans having easy open ends.

Furthermore, the process readily lends itself to automation using high speed can making machinery capable of forming cans at rates of perhaps
10 300 per minute or greater. The quality and integrity of the heat sealing operation can readily be tested and verified.

The neck 14 in the can body 13 provides a neat appearance to the can when cap 12 is secured thereto, since the skirt 22 depending downwardly
15 from disc 21 is of the same diameter as body portion 13a. The neck 14 therefore provides for a generally flush appearance to the can end.

Alternatively the cap diameter can be made the same as the seam diameter on the opposing end of the can, so that the can will roll satisfactorily
20 during existing processes. This is shown schematically at 130 in Figure 4.

Figure 4 also shows use of an optional, rippled form 121 of the upper wall of cap 12. This assists in resisting the cooking pressure in a *per se* known
25 manner.

Figure 3 shows the membrane 11 in its preferred form, ie. an upper, metal foil layer 11b having its lower surface coated with eg. polypropylene 11a.

CLAIMS

1. A container assembly comprising an open-ended container and a closure system therefor including:
 - 5 (i) flexible membrane closing the open end of the container;
 - (ii) a seal between the flexible membrane and the container; and
 - (iii) a rigid closure mounted on the container having a resiliently deformable member juxtaposed to the flexible membrane, the resiliently deformable member pressing the flexible membrane against the container10 in the vicinity of the seal, thereby reinforcing the seal sufficiently to withstand pressures generated on heating of the contents of the container.
2. A container assembly according to Claim 1 wherein the container and the rigid closure include a respective cam and follower, relative15 movement between the cam and follower in a predetermined direction causing the rigid closure and the container to approach one another, thereby increasing the pressure exerted by the resiliently deformable member on the flexible membrane.
- 20 3. A container assembly according to Claim 2 wherein the cam and follower include co-operating screw threads formed respectively on the container and the rigid closure.
- 25 4. A container assembly according to any preceding claim wherein the container includes a neck having an annular flange defining the said seal, the resilient member being substantially congruent with the flange whereby the resilient member presses the flexible membrane against the flange.

5. A container assembly according to Claim 2 or any claim dependent therefrom, wherein the rigid closure includes a laminar member and an annular skirt depending downwardly therefrom, the cam or the follower being provided on an inner wall of the skirt.

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6. A container assembly according to Claim 5 wherein the laminar member is a circular disc, the skirt depending from the outer periphery thereof.

10 7. A container assembly according to Claim 5 or Claim 6 wherein the laminar member is spaced from the flexible membrane by a distance less than the maximum possible extension of the flexible member towards the laminar member.

15 8. A container assembly according to any preceding claim wherein the resiliently deformable member comprises a foamed material secured to the rigid closure.

20 9. A container according to any preceding claim wherein the flexible membrane comprises a metal foil or a plastic film with a functional barrier layer adhesively secured on the container neck.

10. - A container assembly according to any of Claims 4 to 9 wherein the container neck is generally cylindrical.

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11. A container assembly according to any preceding claim including a lifting tab hingeably secured to the flexible membrane by the same material as that of the flexible membrane.

12. A container assembly according to any preceding claim in which the container is a metal, plastic or composite can.
13. A container assembly according to Claim 12 wherein the rigid cap supports of the body of the can in a radial direction.
14. A method of forming a container assembly according to Claim 2, comprising the steps of:
- (i) securing a flexible membrane on the open end of the container by use of adhesives or heat-sealing, thereby forming a seal;
 - (ii) engaging the cam and follower of a rigid closure and the container with one another; and
 - (iii) moving the rigid closure and the container relative to one another to cause relative movement between the cam and follower in the predetermined direction, thereby causing the resiliently deformable member to press the flexible membrane against the container in the vicinity of the seal sufficiently to maintain the seal against pressures generated in the container on heating of its contents.
15. A method according to Claim 14 wherein the container has a neck including the step of securing the said flexible membrane on the open end of the said container neck by use of a heat-sealing method such as heat contact, ultrasonic, induction or hot air heating.
16. A method according to Claim 14 wherein the step of moving the rigid closure and the container relative to one another includes rotating the rigid closure and the container relative to one another.

17. A method according to Claim 14 or Claim 16 wherein the container has a neck and wherein the step of adhesively securing the flexible membrane on the open end of the container includes the sub steps of applying adhesive material to the flexible membrane and/or the container neck; engaging the flexible membrane and the container neck with one another to define the seal; and curing the adhesive material.

18. A method according to Claim 17 wherein the substep of curing the adhesive material includes heating thereof.

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19. A method of packaging a food product, comprising the steps of placing the food product in an open ended container; closing the open end of the container with a container closure to provide a container assembly according to any of Claims 1 to 13; and heating the container assembly and the food product therein, the container closure system maintaining the seal between the flexible membrane and the container during such heating.

20. A method of packaging a food product comprising the steps of closing an open end of a container having two open ends with a closure to provide a container assembly according to any of Claims 1 to 13; placing a food product in the container; closing the other open end of the container by flanging a container end thereto; and heating the container and the food product therein, the container closure system maintaining the seal between the flexible membrane and the container during such heating.

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21. A method according to Claim 19 or Claim 20 wherein the step of heating includes cooking the food product in the container.